



ATTORNEY DOCKET NO. 1567.1059

DECLARATION UNDER 37 C.F.R. 1.131(a)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Jea-Woan LEE

Serial No. 10/691,476

Group Art Unit: 1745

Confirmation No. 5031

Filed: October 23, 2003

Examiner: Laura S. Weiner

For: **NEGATIVE ELECTRODE FOR LITHIUM BATTERY AND LITHIUM BATTERY
COMPRISING SAME**

Declaration Under Rule 131(a)

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Dear Sir:

I, Jea-Woan LEE, the Applicant in the above identified patent application declares as follows:

1. On July 12, 2002, I submitted an invention disclosure form disclosing the invention recited in the above identified patent application. A copy of the invention disclosure form, along with a statement that the translation of the invention disclosure form is accurate, is attached hereto.
2. On October 25, 2002, I filed Korean Application No. 2002-65484 in the Korean Intellectual Property Office. A certified copy of the Korean Application No. 2002-65484 was filed in the United States Patent Office on July 22, 2004, and was acknowledged in the Office Action mailed October 16, 2006. An English translated copy of the certified priority document is attached hereto, along with a statement that the translation of the certified copy is accurate.
3. As indicated in the invention disclosure form, I performed the experiments set forth in the invention disclosure form on page 3 and as Examples 1 to 3 as set forth in the instant patent application. These experiments correspond to the invention as presently claimed.

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The Declarant further states that the above statements were made with the knowledge that willful false statements and the like are punishable by fine and/or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that any such willful false statement may jeopardize the validity of this application or any patent resulting therefrom.

By:



Date:

January 15, 2007

Jea-Woan LEE

Verification Statement For Translation

I, YOM, Chol-jong, hereby declare that I am conversant in the Korean and the English languages and that I am the translator of the document attached and certify that to the best of my knowledge and belief the following is a true and correct English translation of the INVENTION REPORT.

Signature : 영철종 YOM, Chol-jong
Date : January 16, 2007

Application of the Invention or Utility

1. Title of the Invention or utility

(Briefly write about the contents of the invention or utility)

A tapping method for current-collecting of a lithium electrode

2. The detailed description of the invention or utility

(Write the objects, structure, functions, and effects of the invention or utility in detail such that those skilled in the art can easily implement the invention or utility. If there is not enough space, use additional A4-size paper for each item.)

The present invention relates to a lithium metal battery, and more particularly, to a current-collecting method of a battery that uses a lithium metal.

In order to use a lithium metal as an electrode, a metal tab, particularly a 10 μ m- to 50 μ m-thick metal sheet, is used for a current collector. For an easy and strong attachment between the lithium and the metal tab, the portion of the lithium to be attached to the metal sheet is brushed more than once so that the lithium has a surface roughness. Alternatively, a nickel foam with porosity is placed on the surface of the lithium and then pressed. The lithium is forced into the pores of the foam, implementing a strong attachment between the lithium and the foam. Further alternatively, metal sheets are placed on both sides of the lithium and then welding is performed to obtain a strong attachment.

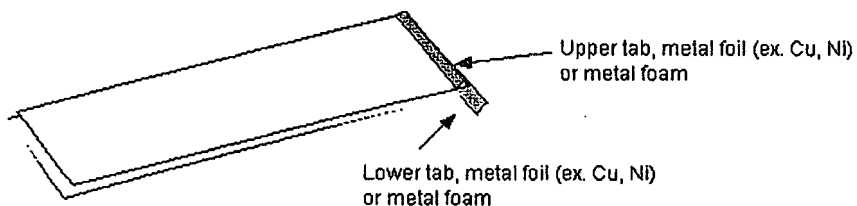


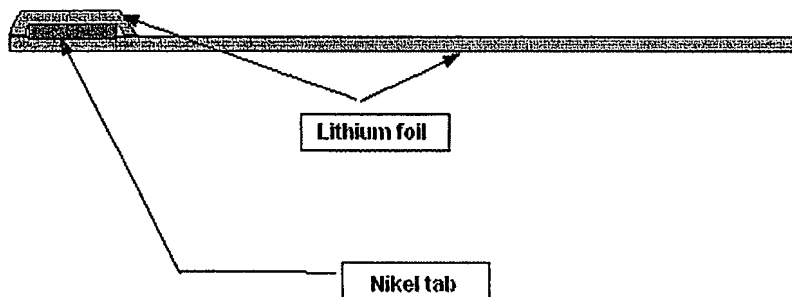
Fig. 1: a welding method suggested in the present invention

3. Related arts

(Write contents and problems of conventional technologies, desirably with reference to drawings. If there are related references or patent publications, make a comment on them as necessary.)

A nickel tab is placed on a lithium foil and then lithium is placed thereon

to wrap the nickel tab with lithium. Thereby, the possibility of a short that can occur due to the nickel tab is lessened. However, this method has a problem that the lithium foil may decrease efficiency of a battery capacity.



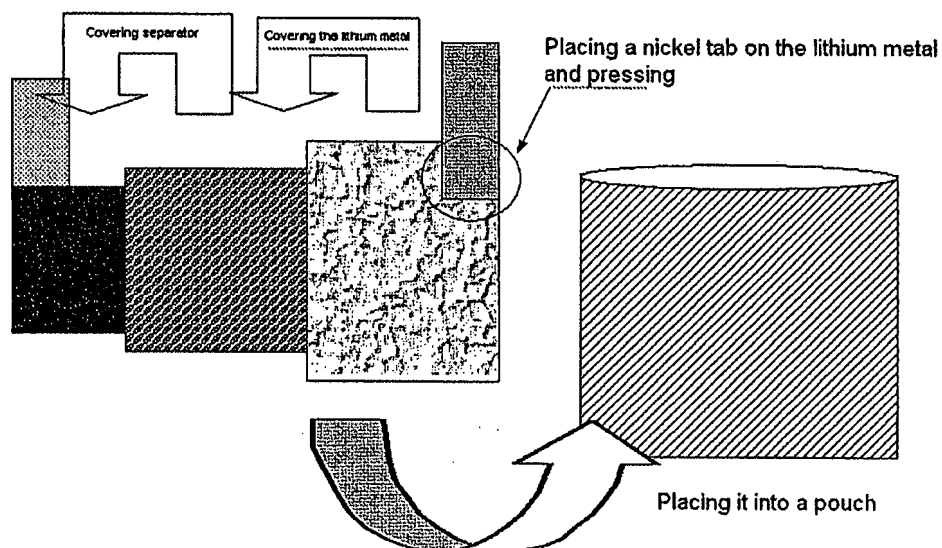
4. Detailed description of the invention or utility

(Write a detailed structure of the present invention or embodiment by referring to reference numerals of the drawings. If there are any other embodiments, or other alternatives, make a comment on them without exception. When a manufacturing method is described, follow the procedural steps.)

Comparative Example 1

A bicell was fabricated using a 200 μ m-thick lithium foil electrode.

First, a positive electrode was cut and then welded with an Al tab. A 100 μ m-thick nickel tab was placed on the 200 μ m-thick lithium foil and pressed to fabricate a negative electrode. A separator was placed on the positive electrode and then the negative electrode was placed on the separator. The resulting product was put into a pouch and an electrolyte was injected into the pouch, followed by sealing. 30 cells were fabricated and the internal resistance (IR) and open circuit voltage (OCV) of the cells were measured.



Example 1

A cell was fabricated the same as in Comparative Example 1 except that the lithium foil was brushed to have a surface roughness and a 10 μ m-thick Cu foil was used instead of the nickel tab. The Cu foil was placed on the surface-roughed lithium foil and then pressed. 30 cells were fabricated and IR and OCV of the cells were measured.

Example 2

A cell was fabricated the same as in Comparative Example 1 except that a 100 μ m-thick Ni foam was used instead of the nickel tab. 30 cells were fabricated and IR and OCV of the cells were measured.

Example 3

A cell was fabricated the same as in Comparative Example 1 except that 100 μ m-thick Cu foils were placed on both sides of the lithium foil and then welded. 30 cells were fabricated and IR and OCV of the cells were measured.

The IR and OCV were measured using an instrument (model 3550 of HIOKI E.E. Corporation)

Table 1: Measurement Results of IR and OCV of the Cells

	Comparative Example 1		Example 1.		Example 2.		Example 3.	
	IR(Ω)	OCV	IR(Ω)	OCV	IR(Ω)	OCV	IR(Ω)	OCV
1	fail	3.20	5.4	3.20	9.3	3.23	8.3	3.22
2	24	3.24	5.8	3.21	8.9	3.19	9.0	3.22
3	26	3.20	5.5	3.20	8.5	3.21	9.7	3.20
4	27	3.20	5.3	3.20	8.8	3.22	16.0	3.22
5	15	2.50	4.8	3.20	10.9	3.04	7.8	3.22
6	fail	2.45	5	3.20	10.0	3.17	11.4	3.20
7	25	3.23	5.5	3.22	9.2	3.12	16.0	3.21
8	23	3.22	5.5	3.20	11.7	3.18	15.0	3.23
9	27	3.17	5.3	3.20	6.8	3.22	10.0	3.26
10	fail	3.18	6.2	3.20	10.5	3.21	9.6	3.25
11	23	3.19	4.3	3.20	12.5	3.17	9.2	3.16
12	22	3.19	4.0	3.20	10.3	3.21	9.5	3.16
13	17	3.19	3.9	3.20	fail	3.22	11.6	3.18
14	25	3.21	4.5	3.20	11.1	3.20	10.7	3.14
15	fail	3.17	2.8	3.20	7.7	3.22	9.9	3.12
16	fail	3.17	4.6	3.20	7.0	3.22	12.4	3.18
17	fail	3.21	4.7	3.20	11.3	3.20	7.5	3.22
18	29	3.20	4.2	3.20	8.5	3.21	11.2	3.21
19	24	3.24	4.0	3.21	9.2	3.20	13.2	3.17
20	22	3.20	4.2	3.20	fail	3.22	11.0	3.21

21	26	3.20	5.2	3.20	7.3	3.21	9.6	3.19
22	24	3.22	4.5	3.20	10.9	3.16	12.5	3.23
23	28	3.18	4.3	3.20	15.5	3.22	11.3	3.19
24	29	3.15	4.2	3.20	14.5	3.19	12.0	3.21
25	fail	3.22	4.8	3.20	9.5	3.19	8.6	3.22
26	25	3.17	4.5	3.20	9.1	3.16	7.9	3.04
27	26	3.18	4.8	3.20	8.7	3.16	12.2	3.17
28	23	3.18	4.7	3.20	9.0	3.18	9.4	3.17
29	off	3.21	5.2	3.20	11.1	3.21	9.5	3.16
30	off	0	4.8	3.20	10.2	3.18	9.0	3.12

5. The Effect of the Invention or Utility

(Write effects of the invention in detail one by one. If there are experimental values, describe quantitatively by mentioning specific numbers. For example, a good product rate is increased from 95% to 98%.)

The cells of the present invention can decrease IR and thereby improve high rate properties. Further, the cells of the present invention can inhibit a short-circuit.

6. What is claimed is:

A. Independent Claims

(Write the essential structure of the invention to be protected with more than one claim specifically. Typically, independent claims appear in the summary of the invention.)

1. A method of tabbing for current collecting, comprising a 10 μm - to 50 μm -thick metal sheet.
2. A metal tab is physically attached with lithium, the metal tab being a metal foam with pores.
3. A metal tab is placed on both sides of lithium and attached by welding.

B. Dependent Claims

(Make a technical limitation to or further specify the structure of the invention registered in the independent claims. Typically, parts of the embodiments of the invention are taken and written in the dependent claims.)

1. The tab or sheet is made of one of nickel, iron, and copper.
2. The tab has a form of a sheet or foam.
3. The foam has a porosity ranging from 50% to less than 100%, and preferably from 80% to 95%.
4. Welding is performed as follows: tabs that have the same area are placed on both sides of the lithium foil and then welded.
5. The lithium electrode is a lithium metal foil or lithium that is deposited or pressed on a polymer film or a metal foil.
6. The lithium foil is Cu in item 5.
7. The counter electrode with respect to the lithium electrode is selected from the group consisting of an active sulfur (S₈), polysulfide dissolved in a catholyte, an organo sulfur, and combinations thereof.

1

발명·고안의 명세서

2

1. 발명·고안의 명칭 (발명의 내용을 간명하게 기재할 것)

3

리튬전극의 집전을 위한 tabbing 방법

4

5

2. 발명·고안의 상세한 설명

6

(관련기술 분야에서 통상의 기술을 가진 자가 용이하게 실시할 수

7

있을 정도로 발명·고안의 목적, 구성, 작용 및 효과를 상세하게

8

기재하되, 지면이 부족하면 항목별로 A4용지에 추가 기재할 것)

9

본 발명에서는 리튬메탈을 사용하는 전지에 관련된 것으로 특히

10

리튬메탈을 전극으로 사용할 경우의 집전방식에 관한 것이다.

11

본 발명에서는 리튬메탈을 전극으로 사용하기 위해 집전체로서 금속

12

tab을 사용하며, 이때 특히 10 μ m~50 μ m 두께의 금속 sheet를 사용한다.

13

이때 접착을 용이하게 하기 위해서 리튬의 표면을 brush로 1회 이상

14

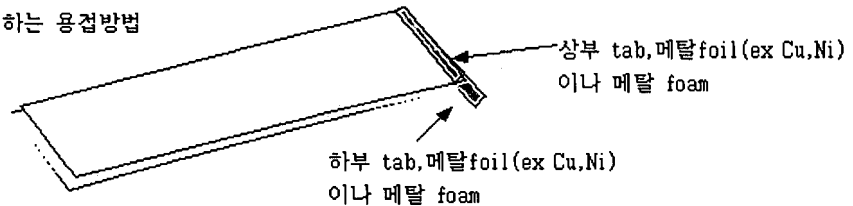
문질러 금속 sheet와 접촉시키고자 하는 리튬의 표면을 거칠게 한 후

15

부착하면 더욱 견고하게 부착된다. 또 다른 방법으로는 기공도를 가진

- 1 니켈foam을 리튬의 표면 위에 올려 놓은 후 압력을 가하면 리튬의
- 2 무른 성질로 인하여 foam사이의 기공으로 리튬이 스며들어 더욱
- 3 견고하게 리튬과 부착시킬 수 있게 된다. 또 다른 방법으로는 리튬의
- 4 양쪽면에 금속 sheet를 올려 놓고 용접을 해 주면 이 또한 쉽고
- 5 견고하게 부착된다.

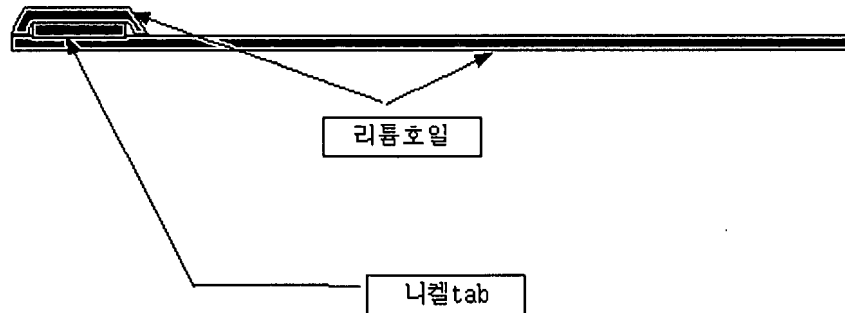
그림 1. 본발명에서 제시하는 용접방법



3. 종래기술의 설명

- 9 (종래기술의 내용, 문제점을 기재하되 도면을 참조하면서 설명함)
- 10 바람직하고 관련된 문헌, 공보등이 있으면 반드시 표기할 것)
- 11 리튬호일위에 금속니켈을 올려놓은후 리튬을 다시 올려놓아 리튬과
- 12 리튬으로 금속니켈 tab을 감싸줌으로써 금속 니켈 tab edge로 인하여
- 13 발생하는 쇼트 현상을 줄이고자 하였다. 이렇게 하여 전지를 제조할
- 14 경우 리튬 foil의 두께가 차지하는 공간만큼 전지의 유효 용량이

1 줄어드는 단점이 있다.



2

3

4 4. 발명·고안의 상세한 구성 및 작용설명

5 (본발명의 도면을 작성 인용부호를 인용하면서 발명의 상세한 구성

6 즉 실시예를 작용과 함께 기재하되, 다른 대안 즉 다른 실시예가

7 있으면 빠짐없이 기술할 것. 단 제조방법은 공정수순에 따라 설명할 것)

8 비교예 1. 리튬 foil 200 μm 을 전극으로 하여 Bi-cell 을 제조하였다.

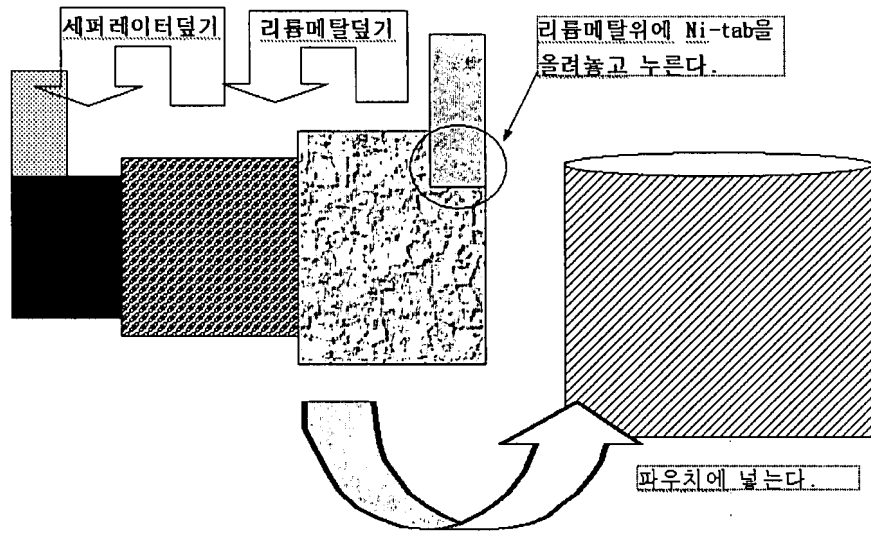
9 제조 순서는 첫번째 양극을 자른 후 Al-tab 을 이용하여 용접을 하였다.

10 그 다음 세퍼레이터를 양극위에 올려놓았다. 그런 후 리튬 foil

11 200 μm 위에 집전을 위해 Ni tab(100 μm)을 올려놓고 눌러 붙인 음극을

12 올려 놓았다. 그런 후 파우치에 넣고 전해액을 넣은 후 실링하였다. 총

13 30 셀 제조 후 IR 과 OCV 를 측정하였다.



- 1
- 2 실시예 1. 비교예 1.의 제조 방법에서 Ni-tab 을 Cu foil($10\text{ }\mu\text{m}$)로
- 3 변경한 것 과 리튬메탈 표면을 brush 를 이용하여 리튬표면을 거칠게
- 4 한 후 그 위에 Cu foil 을 올려 놓고 눌러준 것을 제외하고는 위와 동일
- 5 하다. 총 30 셀 제조후 IR 과 OCV 를 측정하였다.
- 6 실시예 2. 비교예 1.의 제조 방법에서 Ni-tab 을 Ni-foam($100\text{ }\mu\text{m}$)로
- 7 변경한 것을 제외하고 나머지 과정은 동일하다. 총 30 셀 제조후 IR 과
- 8 OCV 를 측정하였다.
- 9 실시예 3. 비교예 1.의 제조 방법에서 Ni-tab 을 올려 놓고 누른다는
- 10 부분이 Cu foil($10\text{ }\mu\text{m}$)을 리튬 foil 양면에 하나씩 댄 후 용접한 것을

- 1 제외하고는 모두 동일 하다. 총 30 셀 제조 후 IR 과 OCV 를
- 2 측정하였다.
- 3 위의 모든 측정은 HIOKI E.E. Corporation 의 model 3550 을
- 4 이용하여 측정하였다.(표 1 참조)

5

6 표 1. 셀 제조 후 IR 과 OCV 측정 결과표

	비교예 1.		실시예 1.		실시예 2.		실시예 3.	
	IR(Ω)	OCV	IR(Ω)	OCV	IR(Ω)	OCV	IR(Ω)	OCV
1	fail	3.20	5.4	3.20	9.3	3.23	8.3	3.22
2	24	3.24	5.8	3.21	8.9	3.19	9.0	3.22
3	26	3.20	5.5	3.20	8.5	3.21	9.7	3.20
4	27	3.20	5.3	3.20	8.8	3.22	16.0	3.22
5	15	2.50	4.8	3.20	10.9	3.04	7.8	3.22
6	fail	2.45	5	3.20	10.0	3.17	11.4	3.20

7	25	3.23	5.5	3.22	9.2	3.12	16.0	3.21
8	23	3.22	5.5	3.20	11.7	3.18	15.0	3.23
9	27	3.17	5.3	3.20	6.8	3.22	10.0	3.26
10	fail	3.18	6.2	3.20	10.5	3.21	9.6	3.25
11	23	3.19	4.3	3.20	12.5	3.17	9.2	3.16
12	22	3.19	4.0	3.20	10.3	3.21	9.5	3.16
13	17	3.19	3.9	3.20	fail	3.22	11.6	3.18
14	25	3.21	4.5	3.20	11.1	3.20	10.7	3.14
15	fail	3.17	2.8	3.20	7.7	3.22	9.9	3.12
16	fail	3.17	4.6	3.20	7.0	3.22	12.4	3.18
17	fail	3.21	4.7	3.20	11.3	3.20	7.5	3.22
18	29	3.20	4.2	3.20	8.5	3.21	11.2	3.21
19	24	3.24	4.0	3.21	9.2	3.20	13.2	3.17
20	22	3.20	4.2	3.20	fail	3.22	11.0	3.21

21	26	3.20	5.2	3.20	7.3	3.21	9.6	3.19
22	24	3.22	4.5	3.20	10.9	3.16	12.5	3.23
23	28	3.18	4.3	3.20	15.5	3.22	11.3	3.19
24	29	3.15	4.2	3.20	14.5	3.19	12.0	3.21
25	fail	3.22	4.8	3.20	9.5	3.19	8.6	3.22
26	25	3.17	4.5	3.20	9.1	3.16	7.9	3.04
27	26	3.18	4.8	3.20	8.7	3.16	12.2	3.17
28	23	3.18	4.7	3.20	9.0	3.18	9.4	3.17
29	off	3.21	5.2	3.20	11.1	3.21	9.5	3.16
30	off	0	4.8	3.20	10.2	3.18	9.0	3.12

1

2 5. 발명·고안의 효과

3 (발명에 의하여 발생한 특유의 효과를 항목별로 구체적으로

4 기재하되, 실험치 또는 경험치가 있으면 가급적 수치로 표시하여

5 정량적으로 기재할 것. 예컨대, 양품률을 95%에서 98%로 향상시킴 등)

1 셀의 내부저항을 감소시켜 고율 특성을 향상 시킬수 있다. 셀의

2 단락현상을 줄일 수 있다.

3

4 6. 청구범위(多項制)

5 가.독립항 (명세서 기재내용중 보호를 받고자 하는 발명의 필수적인

6 구성을 1 또는 2 이상의 항으로 명확 간결하게 기재할 것. 통상 발명의

7 요약부분과 내용이 일치함)

8 1. 전극으로서 리튬을 사용하는 전지에 있어서 집전하기 위한 tabbing

9 방법에 있어서 금속 sheet를 사용하는 데 이 sheet의 두께는

10 10 μ m~50 μ m 이다.

11 2. 금속 tab과 리튬을 물리적으로 부착시키는 경우 금속을 foam과 같이

12 기공이 있는 것을 사용한다.

13 3. 금속 tab을 리튬의 양쪽면에 댄 후 용접을 통해서 부착시킨다.

14

15 나. 종속항 (독립항에 기재된 발명의 구성을 기술적으로 한정하거나

- 1 구체화하여 기재할 것. 통상 발명의 실시예의 기재부분 중 발취하여
- 2 기재함)
- 3 1. 위의 금속 tab이나 sheet로 사용되는 물질은 니켈, 철, 구리 중
- 4 하나이다.
- 5 2. 위의 tab는 plate형태 이거나 foam형태이다.
- 6 3. foam형태의 경우 기공도는 50%이상 100%미만이다. 적절한 것은
- 7 80% ~ 95%이다.
- 8 4. 용접방식은 리튬foil의 양쪽면에 같은 사영을 가지도록 tab을 놓고
- 9 이들 위를 용접기로 용접한다.
- 10 5. 리튬전극의 형태는 리튬메탈 foil이거나 폴리머 film이나 금속
- 11 foil위에 증착되거나 압착되어진 리튬전극이다.
- 12 6. 5에서 금속 foil은 Cu 이다.
- 13 7. 리튬과 대극으로 사용하는 전극의 물질은 다음 중 하나 이거나 또는
- 14 이들의 조합이다.
- 15 active sulfur(S8), polysulfide를 용매에 녹여 사용하는 catholyte,

1 organo sulfur등이다.



Please Date Stamp and return

Reply/Amendment Fee Transmittal, Verified Translation of Inventor's Invention Report, Declaration under Rule 131(a), Translation of Priority Document KR 2002-65484, Copy of Postcard enclosing Certified Copy of Prior Foreign Application, Submission of Certified Copy of Prior Foreign Application, Response (no fees submitted)

APPLICANT(S): Jea-Woan LEE

APPLICATION NO.: 10/691,476

CONFIRMATION NO. 5031

TITLE: NEGATIVE ELECTRODE FOR LITHIUM BATTERY AND LITHIUM BATTERY COMPRISING SAME

FILING DATE: October 23, 2003

DOCKET NO: 1567.1059/DXR:mj

DUE DATE: January 16, 2007



4/16

(12)



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Submission of Certified Copy of Prior Foreign Application, Korean Priority Document 2002-65484, no fees required

APPLICANT(S): Jea-Woan LEE

SERIAL NO:

CONFIRMATION NO. 5031

TITLE: NEGATIVE ELECTRODE FOR LITHIUM BATTERY AND LITHIUM BATTERY COMPRISING SAME

FILING DATE: October 23, 2003

DOCKET NO: 1567.1059 MDS/DXR:cr

DUE DATE:

Please Date Stamp and return

Submission of Certified Copy of Prior Foreign Application, Korean Priority Document 2002-65484, no fees required

APPLICANT(S): Jea-Woan LEE

SERIAL NO:

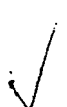
CONFIRMATION NO. 5031

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DUE DATE:





IFW

Attorney Docket No. 1567.1059

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

Jea-Woan LEE

Application No.: 10/691,476

Group Art Unit:

Confirmation No.: 5031

Filed: October 23, 2003

Examiner:

For: NEGATIVE ELECTRODE FOR LITHIUM BATTERY AND LITHIUM BATTERY
COMPRISING SAME

**SUBMISSION OF CERTIFIED COPY OF PRIOR FOREIGN
APPLICATION IN ACCORDANCE
WITH THE REQUIREMENTS OF 37 C.F.R. § 1.55**

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 1.55, the applicant(s) submit(s) herewith
a certified copy of the following foreign application:

Korean Patent Application No(s). 2002-65484

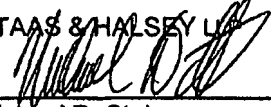
Filed: October 25, 2002

It is respectfully requested that the applicant(s) be given the benefit of the foreign filing
date(s) as evidenced by the certified papers attached hereto, in accordance with the
requirements of 35 U.S.C. § 119.

Respectfully submitted,

STAAS & HALSEY LLP

Date: July 22, 2004

By: 
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